What’s New in HCL RTist 11.1

updated for release 2021.46

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Overview

- RTist 11.1 is based on Eclipse 2020.06 (4.16)
- HCL RTist is 100% compatible with IBM RSARTE. All features in IBM RSARTE are also present in HCL RTist. However, HCL RTist contains some features that do not exist in IBM RSARTE.
  - Those features are marked in this presentation by RTist only

HCL RTist
Version: 11.1.0.v20211115_2304
Release: 2021.46

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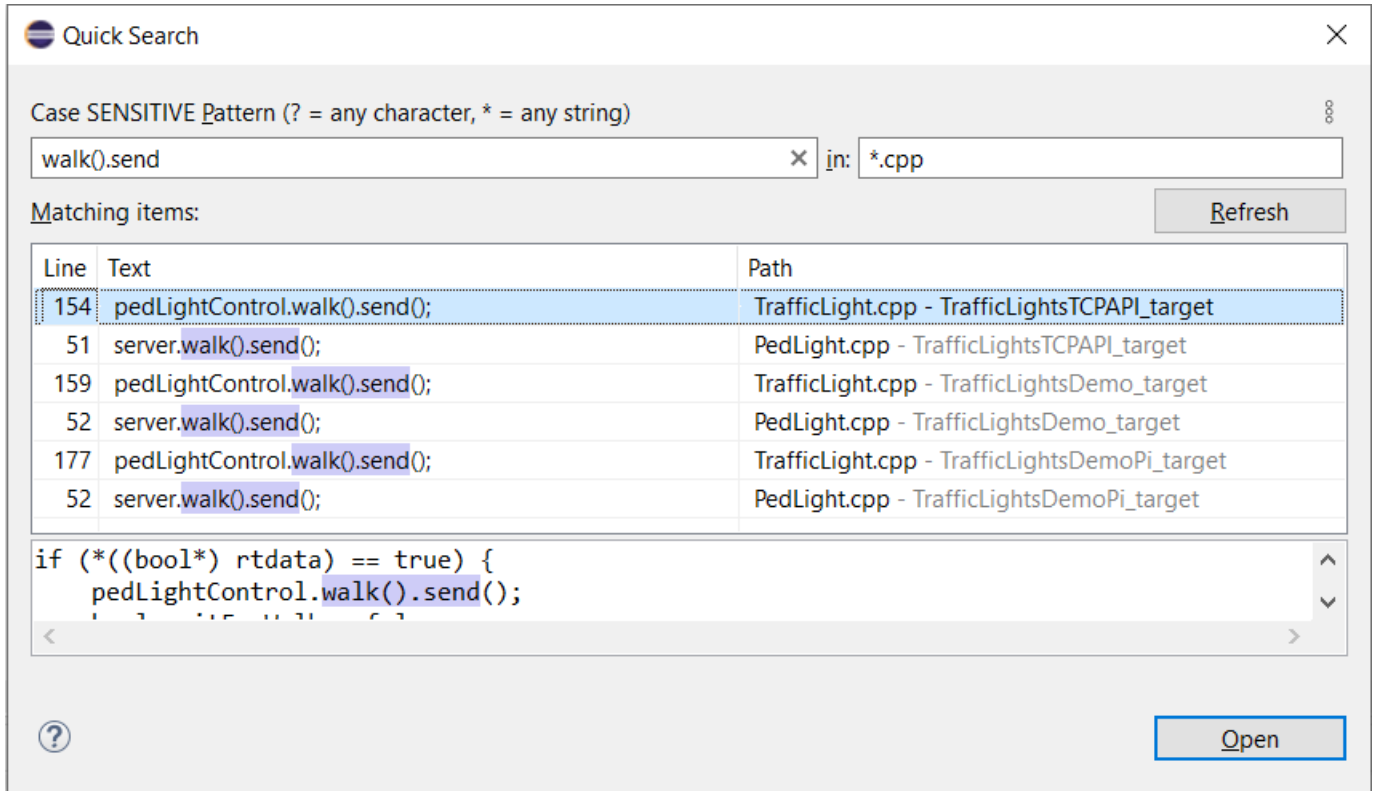
Visit https://RTist.hcldoc.com/help/topic/com.ibm.xtools.rsarte.webdoc/users-guide/overview.html

Eclipse 4.16 (2020.06)

- Compared to RTist 11.0, RTist 11.1 includes new features from 4 quarterly Eclipse releases:
  - 2019.09 (https://www.eclipse.org/eclipse/news/4.13/platform.php)
  - 2019.12 (https://www.eclipse.org/eclipse/news/4.14/platform.php)
  - 2020.03 (https://www.eclipse.org/eclipse/news/4.15/platform.php)
  - 2020.06 (https://www.eclipse.org/eclipse/news/4.16/platform.php)
- For full information about all improvements and changes in these Eclipse releases see the links above
  - Some highlights are listed in the next few slides...

Eclipse 4.16 (2020.06)

- A new Quick Search dialog allows you to search the files of your workspace faster (“as-you-type”)
  - For a similar search experience in model files, use the Find Named Element command instead



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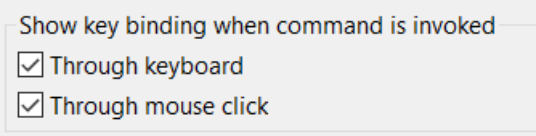
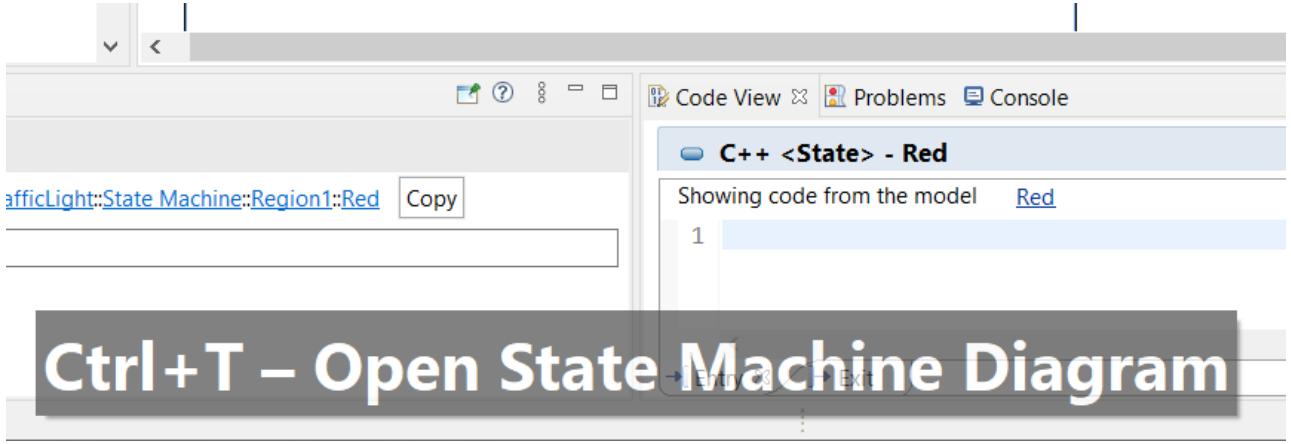
Eclipse 4.16 (2020.06)

- By default at most 99 editors can now be open at the same time
  - Helps keeping the performance good when working with Eclipse for a long time
  - This can be controlled by the preference **General – Editors – Close editors automatically**

- Showing key bindings when performing commands
  - New preferences in **General – Keys**
  - This is a good way to learn about key bindings for the commands that are used, and can also help in presentations





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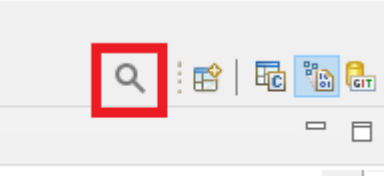
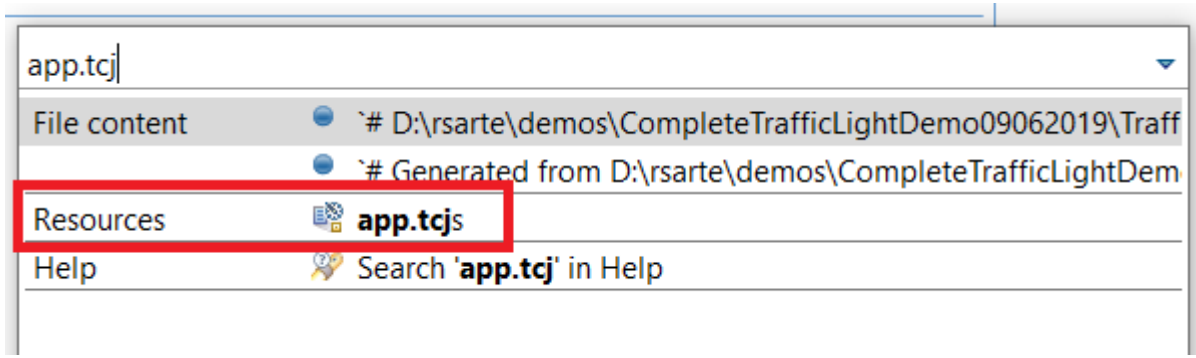
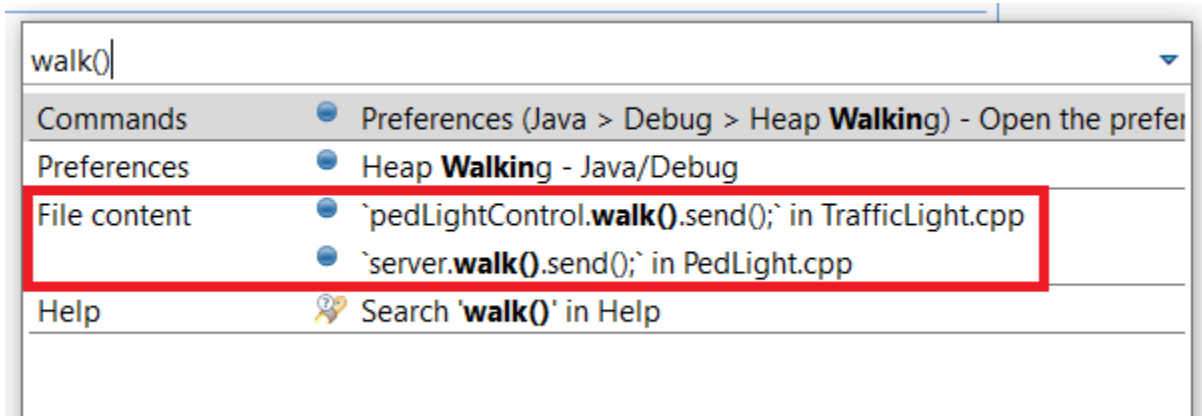
Eclipse 4.16 (2020.06)

- Quick Access field replaced with toolbar button
  - Takes less space in the toolbar, and instead uses a normal dialog for typing an showing the results
  - Same key binding as before (Ctrl + 3) but the command is now called “Find Actions”
  - The results now also include matching files in the workspace, and text matches in files (requires that Quick Search has been used at least once)







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Eclipse 4.16 (2020.06)

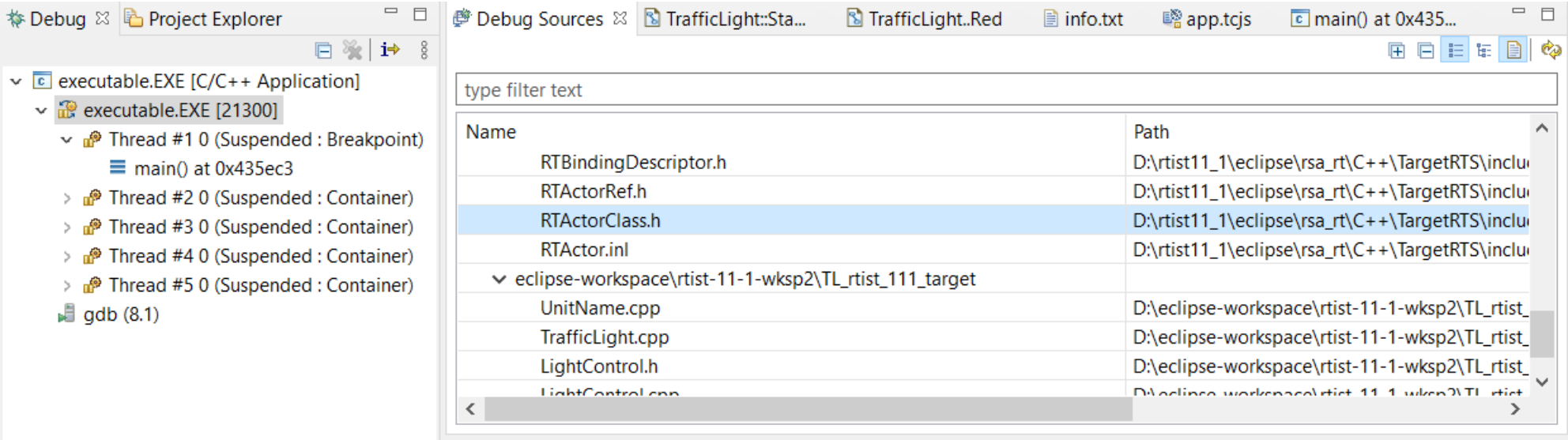
- Show code problems inline
  - Makes errors/warnings more visible and lets you apply quick fixes without having to go to the Problems view
  - Enable this feature in preferences at **General – Editors – Text Editors – Show code minings for problem annotations**

```
34 {
35 //{{{USR platform:/resource/TL_rtist_111/Tr
36 log.log("Red -> Green");
   'cout' is not a member of 'std'
37 std::cout << "test";
38 //}}}USR
39 }
```

- There were several improvements in SWT and GTK
  - The minimal supported GTK version is now 3.20

CDT 9.11 (included as part of Eclipse 2020.06)

- New Debug Sources view
  - Shows source files the C++ debugger knows about when debugging an application
  - Useful in particular when the application contains source files that are not present in the Eclipse workspace
  - Source files can be found by searching (filtering) and opened by double-click



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CDT 9.11 (included as part of Eclipse 2020.06)

- CODAN improvements
  - Several additional checks implemented

- For more information about CDT improvements see
  https://wiki.eclipse.org/CDT/User/NewIn99
  https://wiki.eclipse.org/CDT/User/NewIn910
  https://wiki.eclipse.org/CDT/User/NewIn911

Newer EGit Version in the EGit Integration

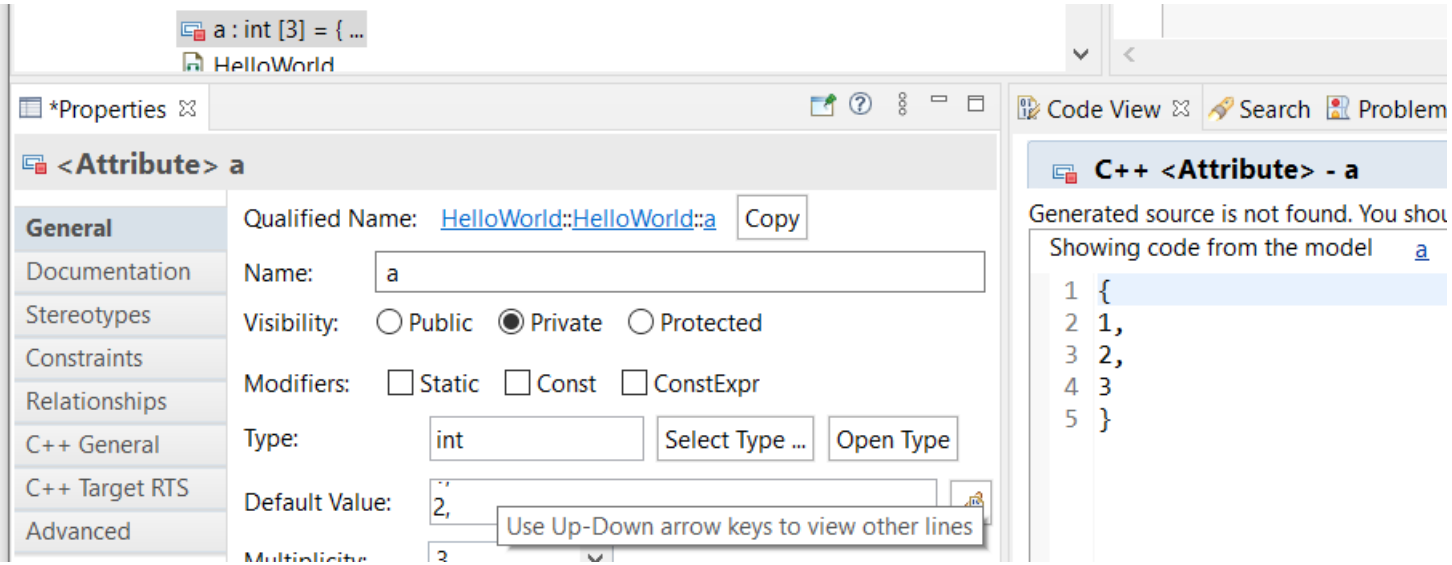
- The EGit integration in RTist has upgraded EGit from 5.4 to 5.8
  - This is the recommended and latest version for Eclipse 2020.06
- This upgrade provides several new features, performance improvements and bug fixes
  - For detailed information about the changes see
    https://wiki.eclipse.org/EGit/New_and_Noteworthy/5.5
    https://wiki.eclipse.org/EGit/New_and_Noteworthy/5.6
    https://wiki.eclipse.org/EGit/New_and_Noteworthy/5.7
    https://wiki.eclipse.org/EGit/New_and_Noteworthy/5.8

Installation Script

- A bash script is now available which helps automating the installation of RTist
  - Download it from the Info Center
  - Works on both Windows and Linux
- In particular useful for installing RTist 11.1 (due to the requirement of using Java 11 for the installation)
  - Choose whether you want to then run RTist with either Java 8 or Java 11
- For documentation on how to configure and use the script see the Info Center.

Properties View Improvements

- The Default Value field now supports multi-line values
  - To create a multi-line default value you still need to use the Code View or Code Editor
  - For editing a multi-line default value you can now use the Properties view, but it's still often more convenient with the Code View or Code Editor
  - For quickly viewing a multi-line default value the Properties view can be handy



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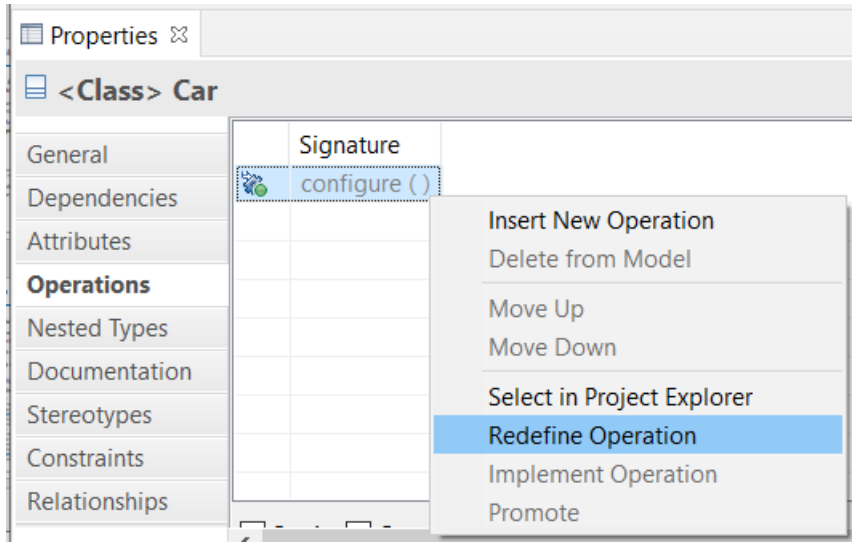
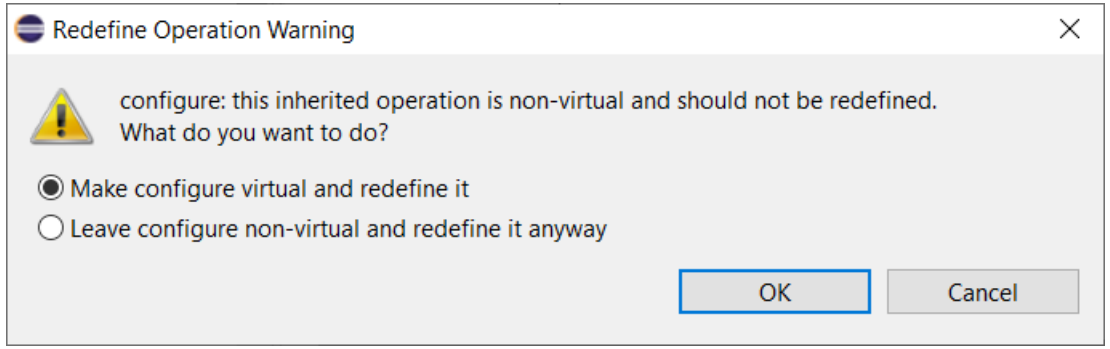
Redefining Non-Virtual Operations

- When redefining a non-virtual operation in the UI, a warning dialog now appears
- By default the dialog suggests to make the inherited operation virtual, so the model (and generated C++) will become correct





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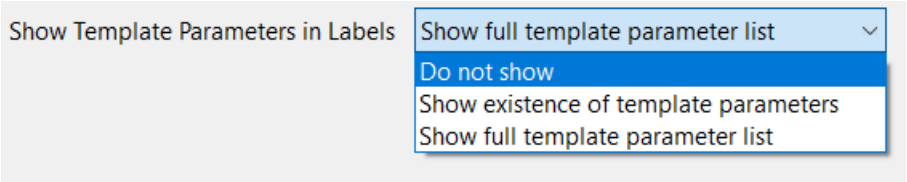
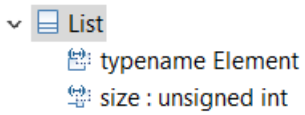
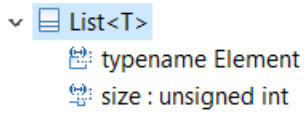
Project Explorer Improvements

- The Project Explorer can now show template information after the name of an element that has template parameters
  - Makes it easier to see if an element is a template without having to expand it in the Project Explorer, or look in the Properties view
  - A new preference **RealTime Development – Project Explorer – Show Template Parameters in Labels** controls what to show

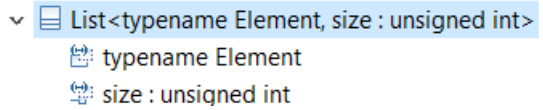




Do not show template parameters



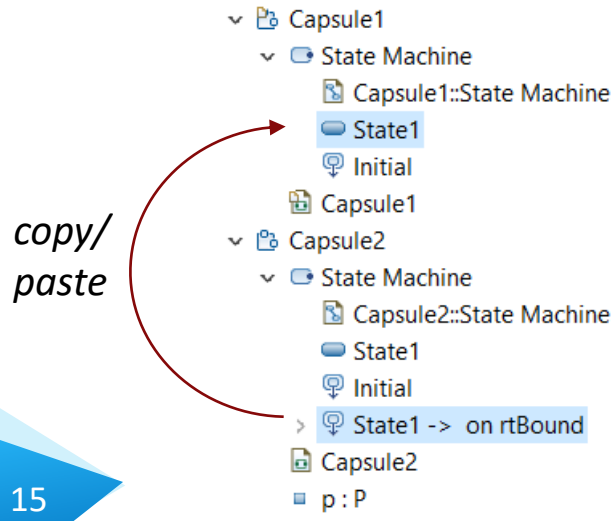
Show existance of template parameters

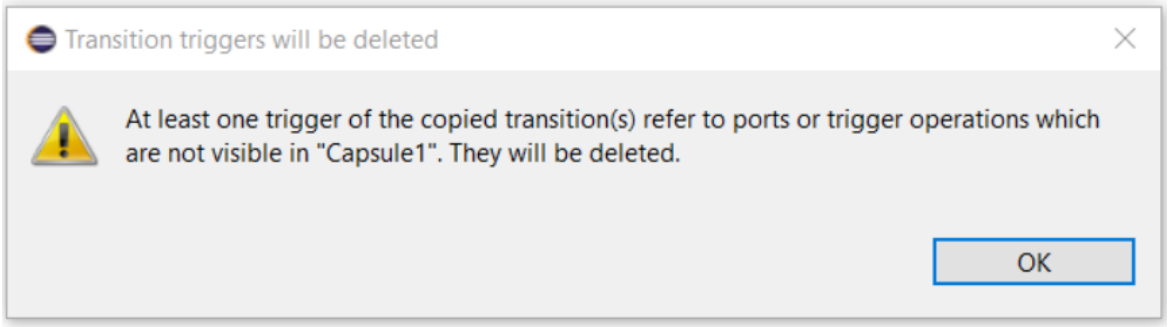


Show full template parameter list

Copy/Paste of Transitions in the Project Explorer

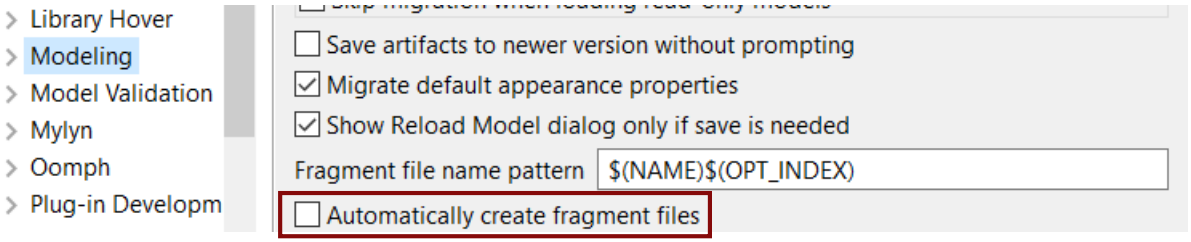
- You can now copy a transition and paste it on a target state using the Project Explorer
  - More convenient than creating a new transition and then copy/paste the effect and guard code (and possibly other transition properties) separately
  - Works for transitions in both capsule and passive class state machines
  - The pasted transition will initially become a self-transition and can be rerouted later if needed
- If ports or trigger operations referenced by triggers of the copied transition are not available in the target context, a dialog will inform that such triggers will be deleted





Automatic Creation of Fragment Files

- A new preference was added for automatically creating fragment files for newly created model elements
  - *Modeling – Automatically create fragment files*

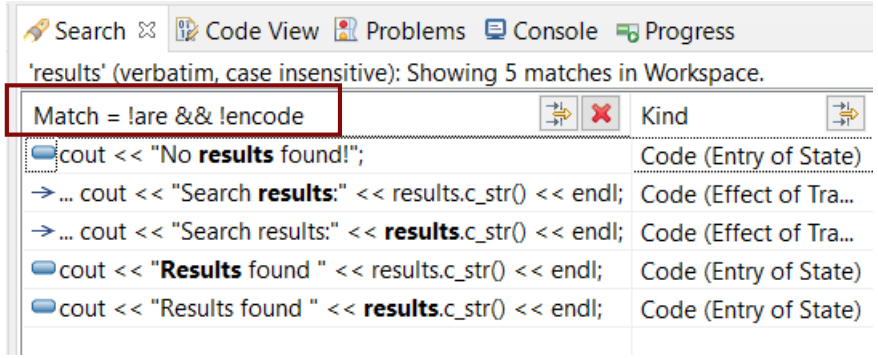


- Setting this preference can be useful if you prefer to always create fully fragmented models

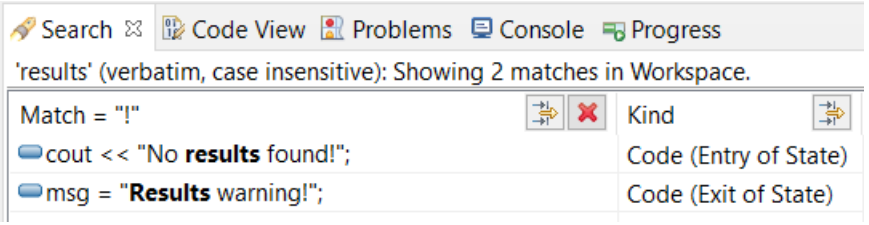
- Note that
  - for state machines no fragment files will be automatically created,
  - fragment file creation cannot be undone,
  - fragment files are not automatically renamed when you rename the element stored in it (use the command **Refactor – Rename file** if you want to rename the fragment file)

Search Filtering

- It's now possible to filter search results using Boolean operators NOT (!) and AND (&&)
  - Useful if a search returns too many matches
  - Use a filter on the form
    `!A && !B && ... !X` to hide matches where certain words <u>are not</u> present
  - Use a filter on the form
    `A && B && ... X` to only show matches where certain words <u>are</u> present
  - ...or any combination, where some words are present and others not

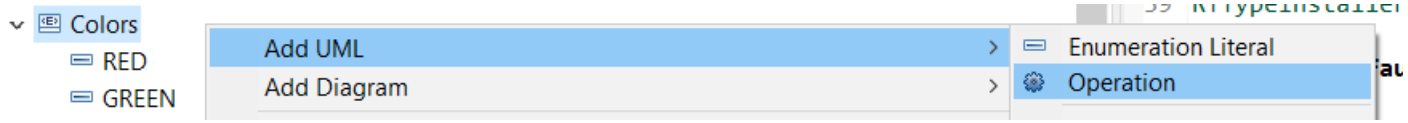


- Enclose the filter string in double quotes to apply the filter verbatimly
  - Needed if the filter string contains the characters ! or &&



Enums with Operations

- Enumerations can now have operations
  - Create them as usual with **Add UML - Operation**



- Such operations will be translated to global functions
  - C++ enums cannot have member functions, but it's sometimes useful to have functions that operate on or return enum literals
  - Using global functions can then be an alternative to wrapping the enum inside a class

- This works the same both for scoped and non-scoped enumerations

Generic Type Descriptors

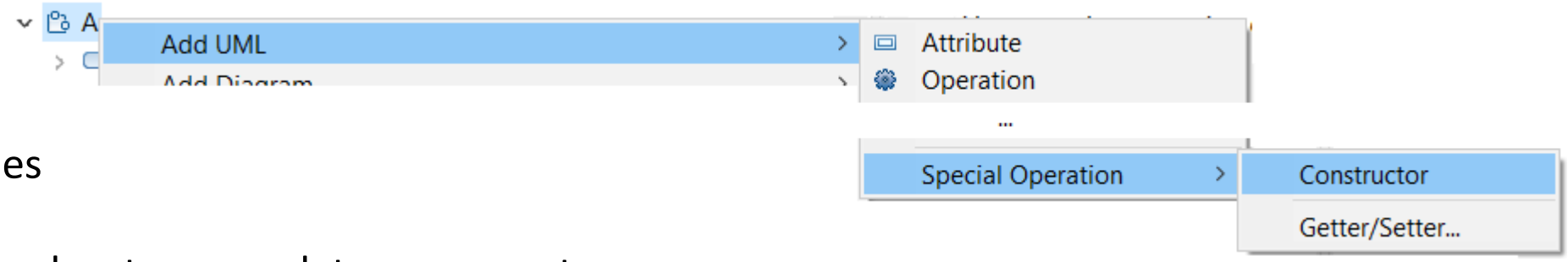
- The model compiler now supports generating type descriptors for type aliases with template parameters
  - For example: `template<typename T, unsigned int N > using StdArray = std::array<T, N>;`
  - If type descriptor functions are defined for the type alias, they will be generated as template functions with the same template parameters
  - Allows to implement generic type descriptors that work for all (or many) instantiations of the template
  - A new `RTObject_class::fromType<T>()` template function can be used for looking up the type descriptor of a type at compile time. Useful for example when implementing generic encode or decode functions. Specialize it for the types that you use (specializations for built-in types are available in the TargetRTS). For example:

```
template <> inline const RTObject_class* RTObject_class::fromType<RTString>() {
    return &RTType_RTString;
}
```

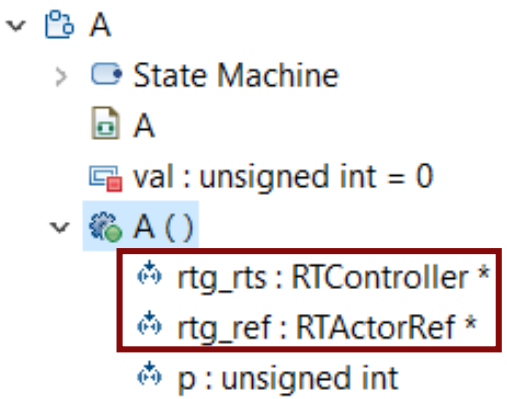
- You can specify a unique name for the type descriptor of a specific template instantiation
  - For example: `template <> const char* RTName_StdArray<StdString, 4>::name = "StdArray<StdString, 4>";`
  - The TargetRTS now prints a warning if two type descriptors with the same name exists. Helps troubleshooting missing template specializations for the name attribute.

Custom Capsule Constructors

- It's now possible to create custom constructors for capsules



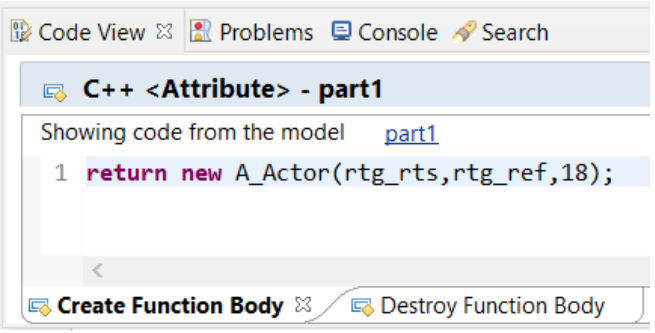
- Each capsule constructor has two mandatory parameters:
  - **rtg_rts** Controller (i.e. thread) that will run the created capsule instance
  - **rtg_ref** Capsule part where the created capsule instance will be inserted



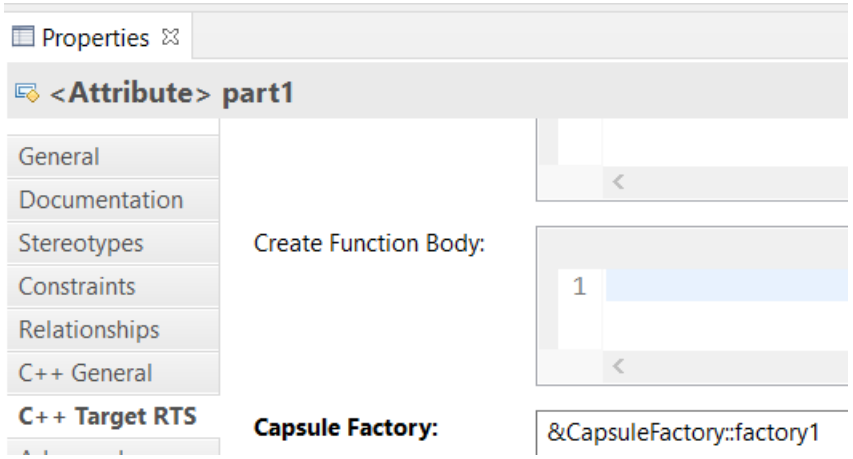
- In addition you can add any number of user-defined parameters
- This feature makes it possible to pass initialization data to a capsule instance already when it's created
  - Previously this could only be done by sending such data with the initialization event (which is not possible for fixed capsule parts)
  - Custom capsule constructors work for all capsules regardless of the capsule part they are incarnated into

Capsule Factories (1/2)

- The concept of a capsule factory was introduced to allow incarnating capsules with custom constructors
  - Specifies how a capsule instance is created and destroyed
  - Can be provided in various ways (in a hierarchical manner)



- New capsule factory code snippets for capsule parts
  - All capsule instances incarnated in that capsule part will use the specified Create/Destroy code



- New capsule factory property for capsule parts
  - Will be used if no Create/Destroy code is provided for that capsule part
- New capsule factory property in the TC
  - Will be used if none of the above are provided
  - Allows specifying a default (global) capsule factory
  - A variable $(CAPSULE_CLASS) can be used in this TC property (expands to the name of the class that is generated from the type of the capsule part)

Capsule Factory: &GlobalCapsuleFactory<$(CAPSULE_CLASS)>::factory2

Capsule Factories (2/2)

- For optional capsule parts, it's also possible to provide the capsule factory using a new TargetRTS function `RTFrame::incarnateCustom()`

```
RTActorId        incarnateCustom( RTActorRef & cp,
                                  RTActorFactory& factory,
                                  int index = -1);
```

  - In this case, only the Create code can be provided (the regular delete operator will be used for destroying such capsule instances)
  - Example usage:

```
RTActorId id = frame.incarnateCustom(part1,
RTActorFactory([this](RTController * c, RTActorRef * a, int index) {
  return new A_Actor(c, a, 444); // User-defined constructor
})
);
```

- If multiple capsule factories are provided, they will be picked in this priority order:
  1. The capsule factory provided in a call to `RTFrame::incarnateCustom()`
  2. The capsule factory specified by means of Create and/or Destroy code snippets on a capsule part
  3. The capsule factory specified by the "Capsule Factory" property on a capsule part
  4. The capsule factory specified in the "Capsule Factory" property on the TC

Dependency Injection

- A capsule normally depends on many things at run-time for its execution
  - Examples: Other capsules typing its capsule parts, the thread that will run the capsule, initialization data to pass to the capsule constructor, etc.
- Spreading out such dependencies in a hard-coded way in an application can make it hard to change them to configure different variants of an application
  - E.g. mocking out dependent capsules when unit testing a capsule
- The TargetRTS now provides a new dependency injection service realized by the RTInjector class
  - Register the dependencies to configure the application (typically early, e.g. in the top capsule constructor)
  - A create function can be registered for a capsule part (identified by its qualified path name)
  - A capsule factory can delegate to `RTInjector::create()` for creating capsule instances
  - If necessary, registered dependencies can be changed at run-time

C++ <Operation> TOP (rtg_rts : RTController *, rtg_ref : RTActorRef *)

Showing code from the model TOP (...)

```
RTInjector::getInstance().registerCreateFunction("/logger:0/logger",
        [this](RTController * c, RTActorRef * a, int index) {
            //return new SimpleLogger_Actor(c, a);
            return new TimestampLogger_Actor(LoggerThread, a);
        }
);
```

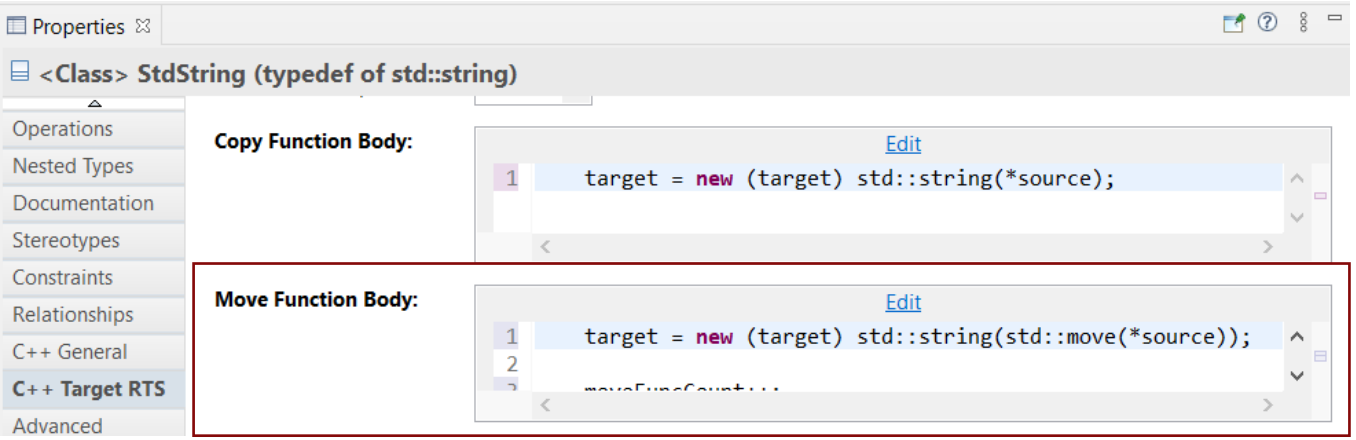
Moving Event Data (1/2)

- The data of an event can now be moved instead of copied when sent between two capsules

```
MyClass mc;
thePort.theEvent(mc).send(); // Send by copy
thePort.theEvent(std::move(mc)).send(); // Send by move
```

- This requires that the event data type is movable, which can be accomplished
  - by having a move constructor, and/or
  - by having a move function defined in the type descriptor

- The move function is a new type descriptor function (describing how to move data from a source to a target object)
  - If the target object has a move constructor, a typical implementation is to invoke it (the model compiler can automatically generate such an implementation)
  - Contrary to other type descriptor functions, the move function is optional (you only need to implement it if the type needs to be movable)
  - If no move function is defined, and an attempt is made to move an object, it will instead be copied

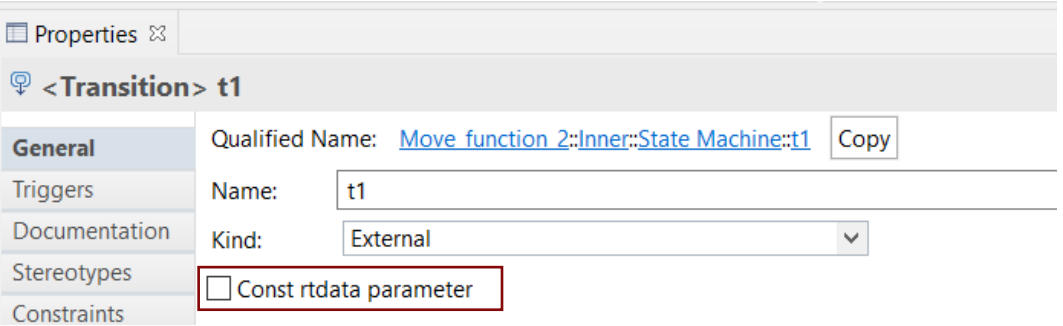


Moving Event Data (2/2)

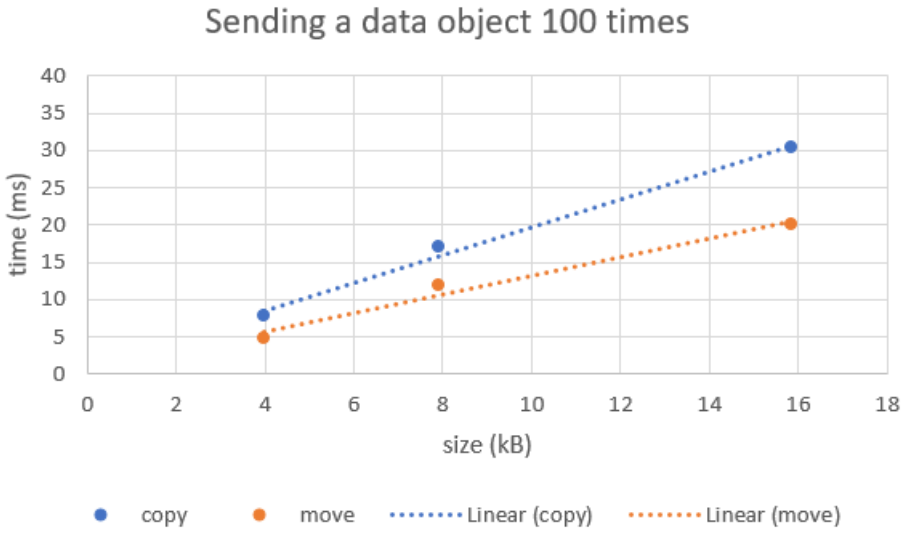
- You can also move the data from a received message into, for example, a capsule attribute

```
someAttr = std::move(*rtdata); // Avoid copying the message data object
```

- This requires that rtdata is declared as non-const (so the move constructor or move assignment operator will be invoked)
  - Can be accomplished by a new transition property



- Moving instead of copying event data can improve application performance if
  - the data object is big, and/or
  - the data object is sent many times



~35% faster

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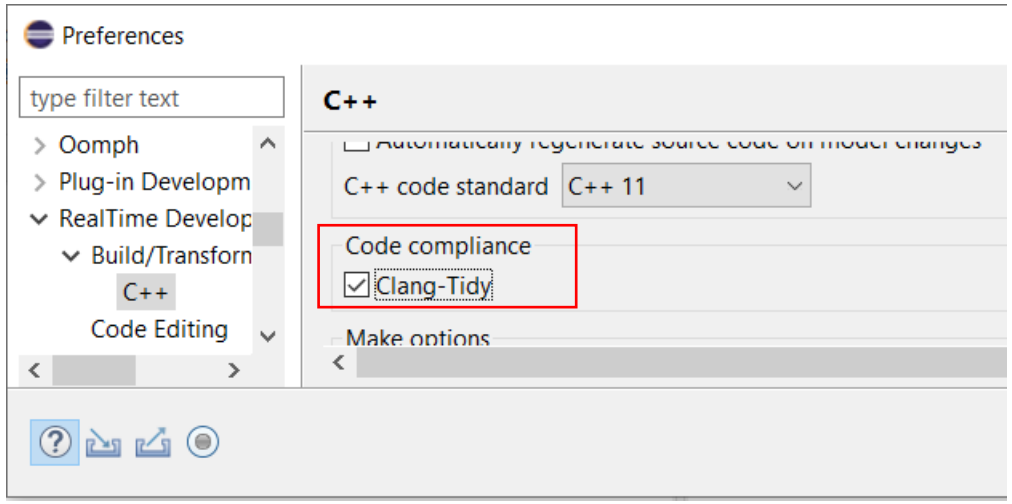
Code Compliance

- A new preference was introduced to let the model compiler generate code according to certain code compliance rules



- Support for these Clang-Tidy rules are implemented:
  - **cppcoreguidelines-pro-type-static-cast-downcast**
    Suppress warnings for use of static_cast to downcast event data in transition functions

```
transition2_t1( static_cast< const bool * > ( msg->data ), static_cast< P::Base * > ( msg->sap()
/* NOLINT(cppcoreguidelines-pro-type-static-cast-downcast) */ ) );
```

  - **misc-unused-parameters**
    Suppress warnings for named function parameters that are not used in the function body

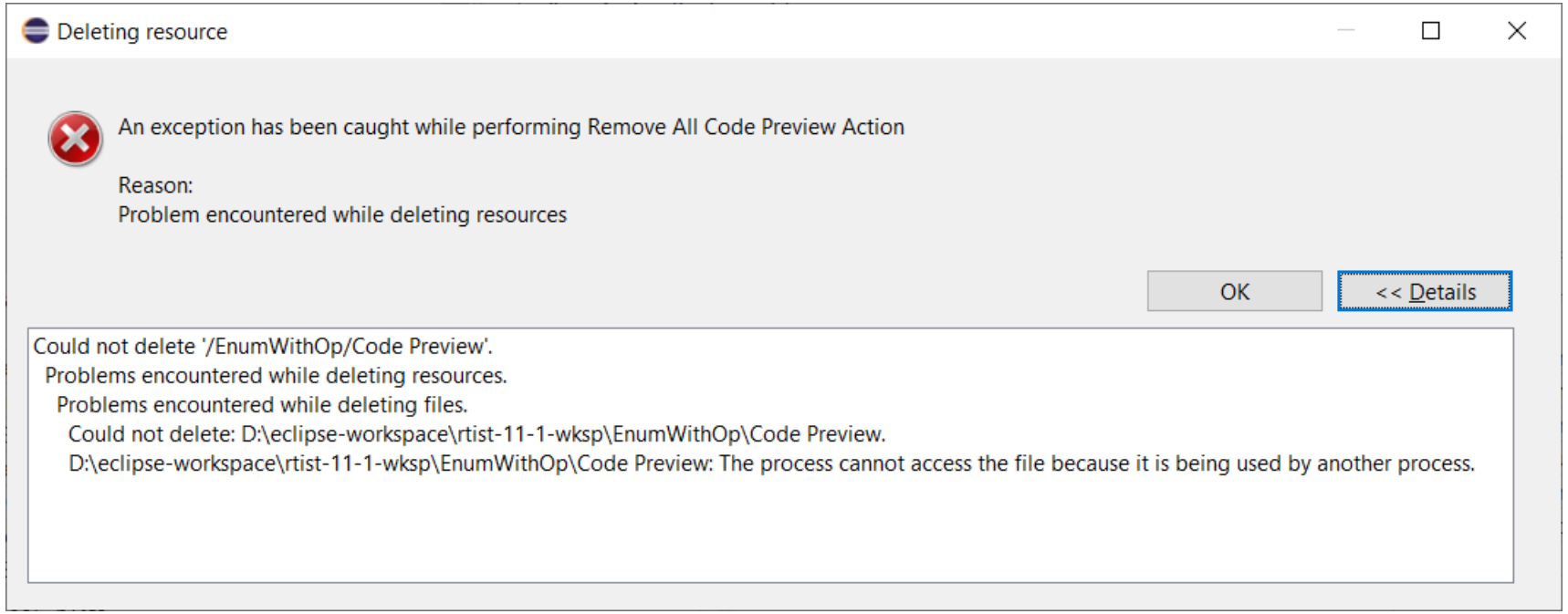
```
static void rtg_B_init(const RTObject_class * type /* NOLINT(misc-unused-parameters) */, B * target );
```

  - **bugprone-sizeof-expression**
    Suppress warnings for computing the size of a pointer type using sizeof

```
, sizeof( SomeClassPtr ) /* NOLINT(bugprone-sizeof-expression) */
```

Error Message when Failing to Delete Files or Folders

- Certain commands in RTist involve deletion of files and/or folders
  - Cleaning a TC
  - Removing code preview
  - ...etc
- Now, if the required files or folders cannot be deleted, a clear error message is shown
  - Previously there would be a silent failure in such situations which could be hard to understand the reason for



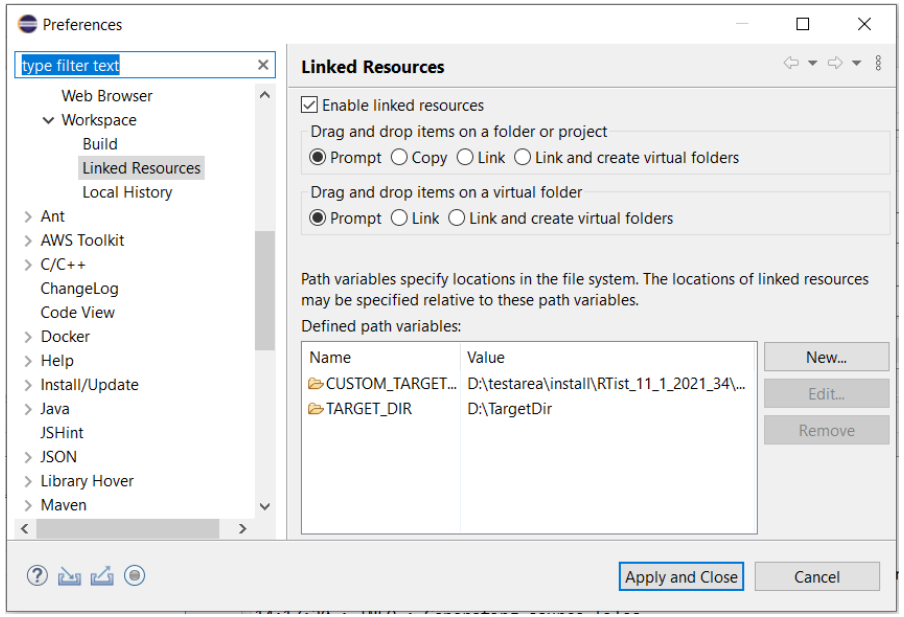
  - The new message is identical to what Eclipse would show if you directly try to remove the files/folders from the Project Explorer. Click the **Details** button to see exactly which file or folder that couldn't be deleted, and why.

More Flexible Model References in Transformation Configurations

- A TC references model elements by means of URIs (e.g. list of source elements, top capsule etc)
- Such URIs can now be relative, and use qualified names instead of unique IDs to identify the element
  - Makes it easier to reuse a TC (e.g. by copy/paste) in different projects
- New preferences control how new URIs will created:
  RealTime Development – Transformation Configuration Editor – Model References

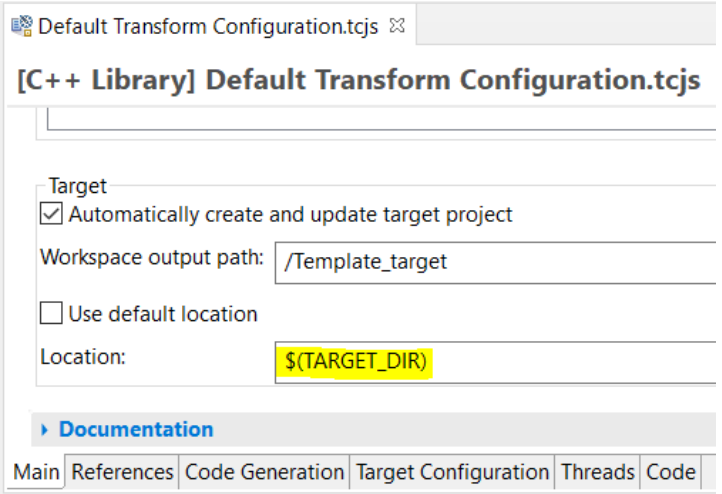
Support for Path Variables in Transformation Configurations

- Path variables can now be used in certain TC properties
  - Useful for those TC properties that specify a path
  - Define path variables in Preferences at **General – Workspace – Linked Resources**
  - This can be an alternative to using string substitutions (**Run/Debug – String Substitutions**) or environment variables in order to have a more generic TC (a path variable takes precedence over other kinds of variables, if the same variable name is used).



- The model compiler now prints a warning if a variable used in a TC property cannot be resolved

```
WARNING : Cannot resolve variable '$(TARGET_DIR)' in
'Location' property:'$(TARGET_DIR)'
```



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New TargetRTS Flag for Faster Plugin Capsule Part Imports

- When importing a capsule instance into a plugin capsule part a run-time check `RTActor::isReferencedBy()` is performed to ensure there are no cycles in the reference graph
- This run-time check can sometimes take too much time
- The TargetRTS now provides a new compile flag `RTIMPORT_ISREFERENCEDBY_CHECK` for disabling this run-time check
  - Set it to 0 in `RTLibSet.h` or `RTTarget.h` to disable the check

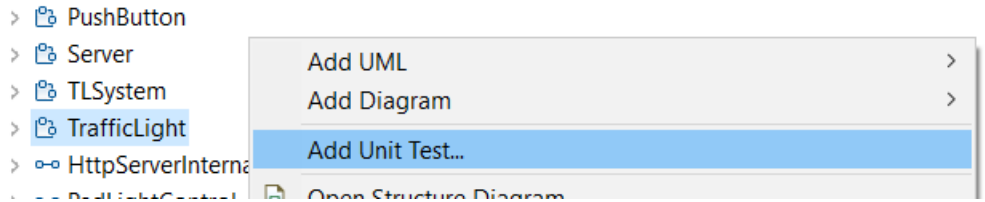
Unit Testing of Capsules using the Mocha Framework (1/3)

RTist only

- Mocha is a popular JavaScript framework for testing asynchronous applications
- It's now possible to use Mocha also for unit testing capsules
  - Provided by a new component that can be selected when installing
  - Note that it depends on NodePlus

simple, flexible, fun

- To create a Mocha unit test for a capsule, invoke the new context menu command **Add Unit Test**



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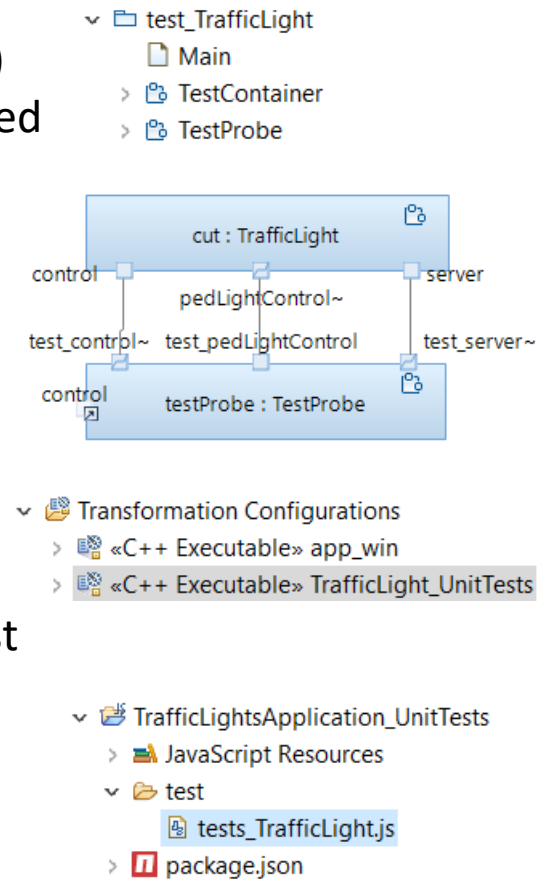
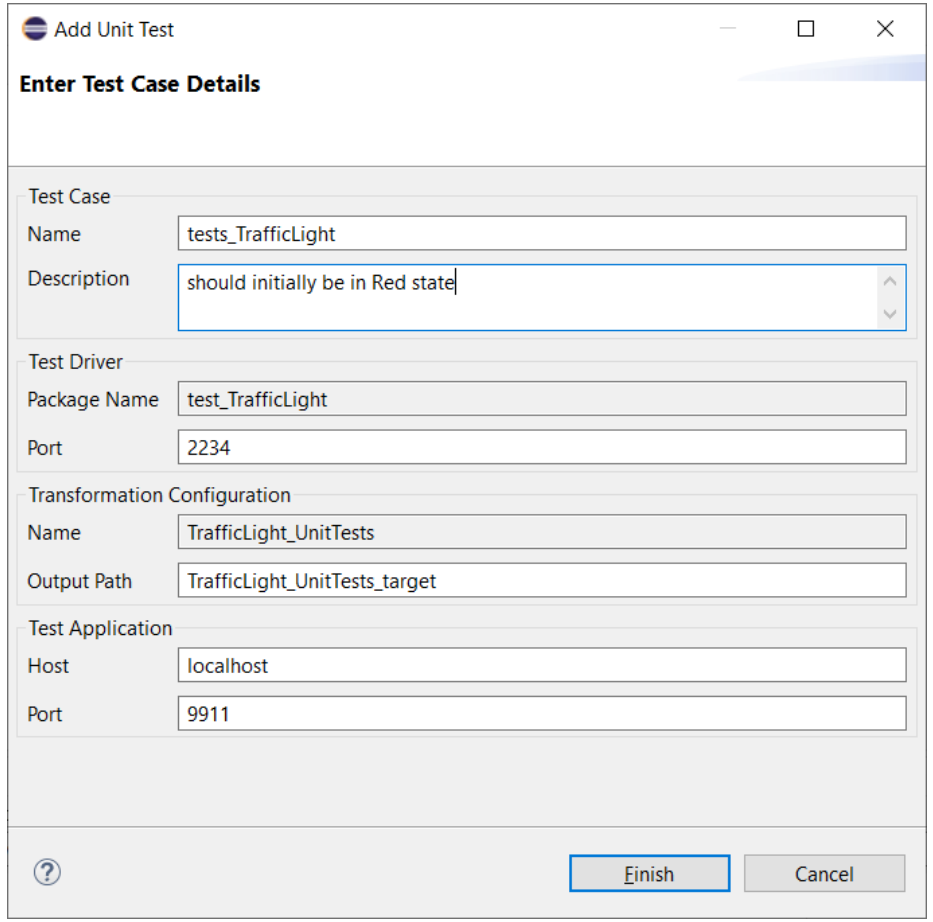
Unit Testing of Capsules using the Mocha Framework (2/3)

RTist only

- The **Add Unit Test** command creates everything necessary for writing a unit test for the capsule
  - A test driver model where all service ports of the capsule under test (”cut”) are connected to similar but conjugated ports of a test probe capsule
  - A TC for building the test driver model into an executable that uses the TcpServer library for exposing all test probe ports to the Mocha test script
  - A Node.js project with a Mocha test script ready to implement the unit test





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Unit Testing of Capsules using the Mocha Framework (3/3)

RTist only

- The unit test can be executed right away
  - Build the test driver TC (only needed the first time, and whenever you change the capsule under test)
  - Install the Node.js dependencies for the JavaScript project (right-click on the project and do **Run As – npm install** (only needed the first time – it is assume you already have installed Mocha on the machine)
  - Run the testcase by right-click on the .js file and do **Run As – JavaScript Unit Test**

tests_TrafficLight.js | TestContainer | TrafficLight_UnitTests.tcjs

```javascript
var assert = require('assert');
describe('TrafficLight', function() {
    it('should initially be in Red state', function() {
        this.timeout(15000);
        const testProbe = require ('rt-test-probe')('localhost', 9911);
        return testProbe.startListenForEvents(2234)
        .then((data) => {
            // TODO: Implement test here
        })
        .finally(() => {
            testProbe.stopListenForEvents();
        });
    });
});
```

- The test execution result is shown in the **JavaScript Unit Test** view

JavaScript Unit Test | Code View | Problems | **Console** | Error Log | Terminal

Runs: 1/1 Errors: 0 Failures: 0

TrafficLight
should initially be in Red state (0,026 s)

Failure Trace

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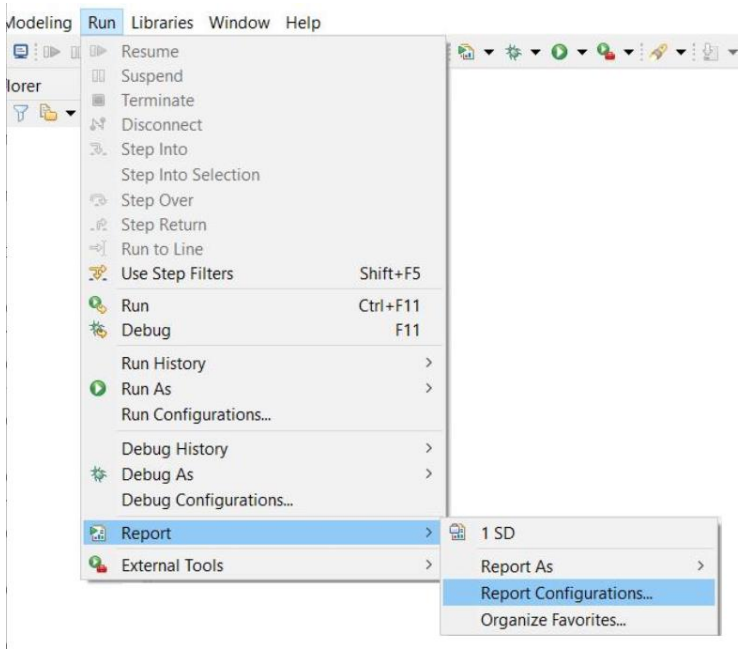
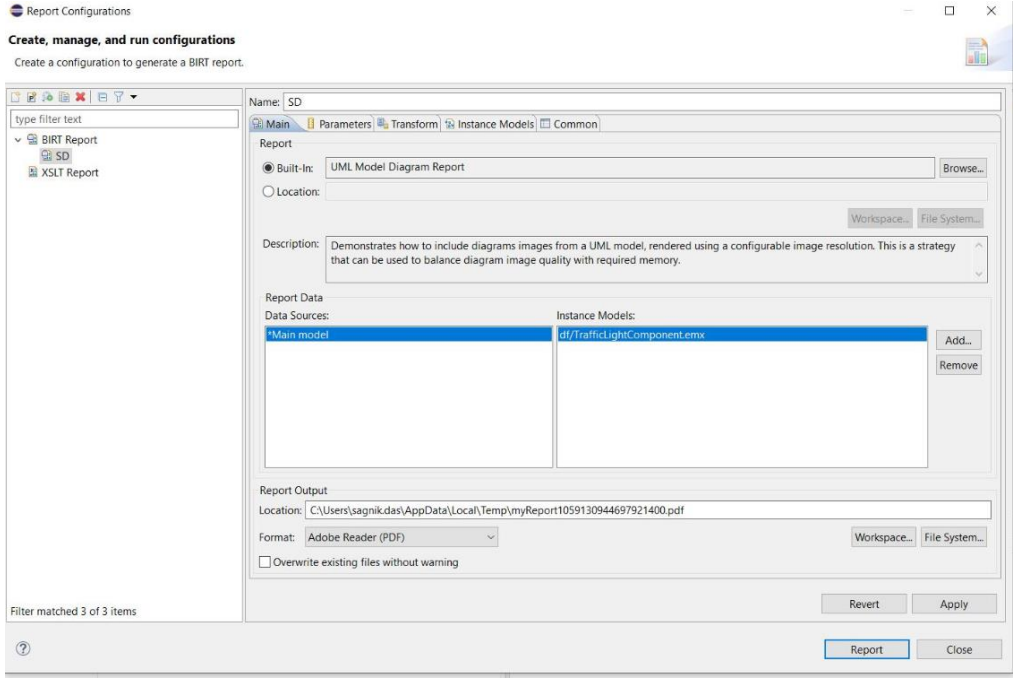
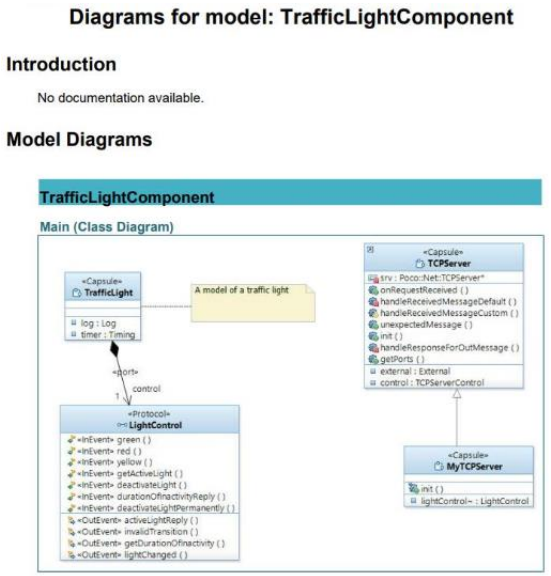
Reporting with BIRT

- Create reports that include information from an RTist model
  - Same capabilities as in RTist 10.3, but now adapted for recent Eclipse versions (supports RTist 11.0 and RTist 11.1)
  - Delivered as a separate update site on [our InfoCenter](). Installation instructions are included in the ZIP file.
  - This is currently an experimental feature







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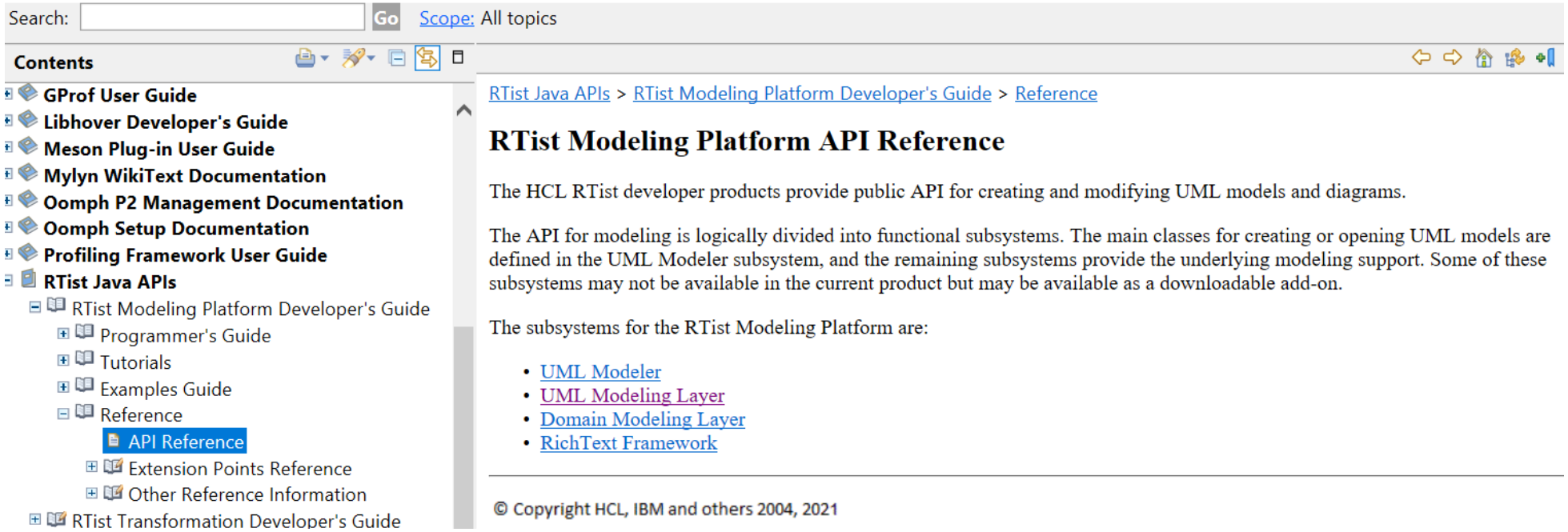
Java API Improvements

- A new method for programmatically redefining an inherited operation was added
  - `com.ibm.xtools.uml.redefinition.RedefFactory.getOperationRedefinition()`
- Read more about this new method in the Help (RTist Java APIs – Reference – API Reference – UML Modeling Layer)



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